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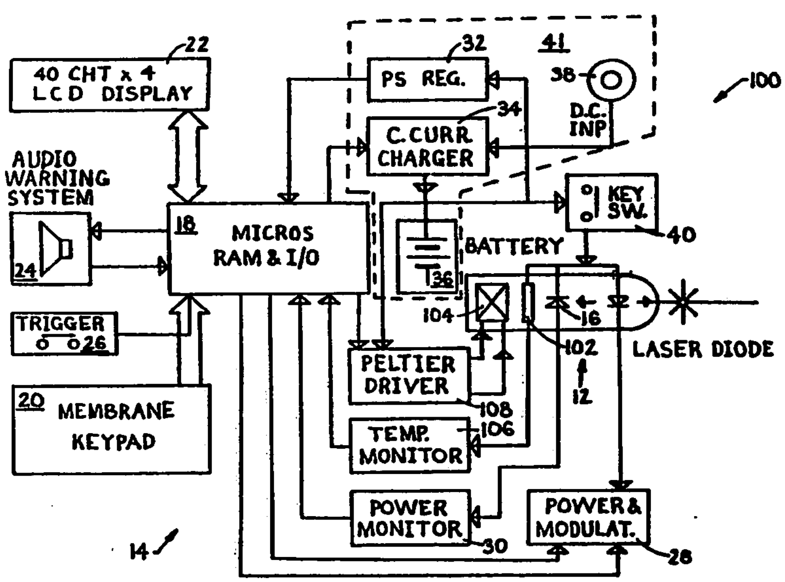
(54) Title: MEDICAL LIGHT TREATMENT APPARATUS





(57) Abstract

A medical light treatment apparatus (MLTA - 10, 100, 200, 300) for use in the medical treatment f biological structures by application of light energy - particularly laser light energy. The MLTA (10, 100, 200, 300) monitors the light reflected back from the biological structure and boosts the light energy output by the laser (12) to couple a desired amount of light energy into the biological structure to effect a known medical treatment. The MLTA (10, 100, 200, 300) has a self-calibrating monitor to monitor the operational characteristics of the laser (12) and adjusts the driving characteristics of the laser (12) to ensure that the laser (12) operates at a substantially constant wavelength. In such manner the MLTA (10, 100, 200, 300) has very accurate control over the laser (12) and can thus serve as a laboratory grade instrument for use in analysing the further medical effects of the laser (12).

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A practical limit to the amount of energy that can be coupled into the biological structure is typically five joules per centimetre square. Greater energy densities tend to lead to damage to the skin and/or underlying or biological structure of the animal and are therefore generally to be avoided. Most medical treatments are based upon the amount of energy that can be coupled into the biological structure per unit time. For example, a 30 mW laser source is said to provide an energy of 1.8 joules per minute into the biological structure i.e. 0.030 watts X 60 seconds = 1.8 joules.

Such application of energy assumes 100% coupling of the laser light energy from the laser source into the biological structure. However, I have discovered that there can be significant reflection of the laser light at the skin surface of the animal. The reflection may be due to natural oils in the skin and scale occurring on skin, but still may occur where these two factors are not present to any significant degree. Indeed, skin viewed under a low power microscope appears quite silvery and seems to be very reflective. Solid state laser diodes incorporate a photodiode which controls the laser diode to prevent it from entering into optical run-away. By the nature of the construction of solid state laser diodes the laser light reflected from the animal's skin is detected, by the photodiode as indicating the laser diode is approaching optical run-away. Accordingly, the photodiode tends to reduce the effective power output of the laser diode. For example, if 20% of the laser light is reflected by the skin only 80% of the laser light enters into the biological structure.

In the prior art medical laser treatment apparatus a solid state laser diode is driven at a power selected to produce the energy required, for the medical treatment, over a fixed period of time. However, since not all of the laser light is coupled into the biological structure the required dosage of energy is not administered. Hence, the effectiveness of the laser light treatment is not as

# TITLE

# MEDICAL LIGHT TREATMENT APPARATUS

## FIELD OF THE INVENTION

The present invention relates to a medical light treatment apparatus particularly, although not exclusively, envisaged for use in medical treatment including acupuncture, dentistry, physiotherapy and veterinary use.

The present invention more particularly relates to a medical light treatment apparatus having interactive control of a light source to provide laboratory instrument grade control of medical treatment thus enabling use in proving the medical worthiness of medical light treatments.

The light energy with which the present invention is concerned is that which is capable of achieving penetration into biological structures in animals including man. Preferably, such light energy is applied to the biological structures by the use of lasers and the present invention will hereinafter be described with particular reference to use of lasers.

I have called this apparatus "ACULITE" - which is an acronym for "Acupuncture Computerised Unit by Laser Intelligent Treatment Energy".

## BACKGROUND OF THE INVENTION

It is known to use lasers in medical treatments of animals including humans by the use of a laser beam located either at a distance from or directly in contact with the skin of the animal. The laser light energy penetrates the biological structure of the animal and can have various therapeutic effects. The therapeutic effect is principally dependent upon the amount of energy delivered to the biological structure which is to be treated. The amount of energy delivered is the product of the energy density of the laser light and the period for which the laser light is applied to the biological structure. Structures just below the skin surface can experience positive therapeutic effects by the application of one to two joules per centimetre square of laser light energy, whereas deeper biological structures require greater amounts of energy.

expected, and the lack of success is not readily explainable by users of the apparatus.

Also, in acupuncture treatments it is known to manipulate an acupuncture needle to further stimulate the meridian points of the animal. In laser light treatments a similar effect to the manipulation of the acupuncture needle is achieved by modulating the power of the laser diode. However, I have discovered that the modulation must be carefully controlled to ensure that there is no distortion introduced by the modulating signal. Where distortion is allowed to occur the effective modulation of the power of operation of the laser diode becomes unpredictable, which can lead to over or under stimulation of the biological structure and hence inaccuracy in the operation of the medical light treatment apparatus. Such inaccuracy makes the apparatus unsuitable for a laboratory grade testing instrument.

## SUMMARY OF THE INVENTION

Thus, it is an object of the present invention to provide a medical light treatment apparatus capable of controlling the treatment of a biological structure of an animal with light.

In accordance with one aspect to the present invention there is provided a medical light treatment apparatus for the treatment of biological structures in animals, including humans, with light energy, the apparatus comprising:

light emitting means for directing light energy into a biological structure of the animal;

light sensing means for detecting light energy reflected back from the animal and for generating a feedback signal indicative of such reflected light energy; and,

control means operatively connected to the light emitting means, the control means being responsiv to said feedback signal;

whereby, in use, said apparatus can accurately control the intensity of the light energy emitted by the light emitting means for increasing the intensity of the light

emitted from the light emitting means when the light sensing means senses light being reflected back from the animal, the control means can thereby control the intensity of the light energy actually penetrating into the biological structure of the animal.

It is another object of the present invention to provide a medical light treatment apparatus in which the power of the light can be accurately modulated for providing further stimulation.

In accordance with another aspect to the present invention there is provided a medical light treatment apparatus for the treatment of biological structures in animals, including humans, with light energy, the apparatus comprising:

light emitting means for directing light energy into a biological structure of the animal;

light sensing means for detecting light energy reflected back from the animal and for generating a feedback signal indicative of such reflected light energy; and,

modulation means operatively connected to the light emitting means, the modulation means being responsive to said feedback signal and responsive to a modulation signal;

whereby, in use, the modulation means can substantially eliminate distortion from the modulation signal and can modulate the intensity of the light energy emitted by the light emitting means according to the modulation signal.

Preferably, the light emitting means is capable of narrow focusing and is substantially non-divergent. More preferably, the light emitting means is a laser and may be either collimated or uncollimated. Typically, the laser is a solid state laser diode which incorporates a photo sensor for preventing the laser diode from entering optical run-away and which can detect light reflected from the surface of the skin of the animal.

Preferably, the control means can control the modulation, duration and/or energy level and the like of the light in a reproducible way such that a medical treatment determined by the user of the apparatus can be replicated by

other people for other animals.

Typically, the biological structures are animal tissue but could include bone.

Typically, the medical treatments include acupuncture, treatments of skin disease, physiotherapy, dentistry and veterinary use.

Accordingly embodiments of the invention provide a solution to the problems in the prior art by measuring the actual energy input into the biological structure and to drive the laser diode to higher power levels (assuming there is head room available) to compensate for the energy reflected and provide the required energy into the biological structure. This is achieved with a control system capable of measuring transmitted and reflected energy levels and able to adjust the transmitted energy level to compensate.

Also, the last embodiment of the invention provides a solution to the problem of distortion in the signal used to modulate the laser diode.

## BRIEF DESCRIPTION OF THE DRAWINGS

Three embodiments, being examples only, of the present invention will now be described in detail with reference to the accompanying drawings, in which:-

Figure 1 is a schematic block diagram of a medical laser treatment apparatus incorporating a laser diode;

Figure 2 is a medical laser treatment apparatus similar to that of Figure 1 but having a laser diode incorporating a peltier driver for temperature stabilisation;

Figure 3 is a medical laser treatment apparatus similar to that of Figure 1 but in which the laser diode is controlled by a slave unit remotely controlled from a master unit of the medical laser treatment apparatus;

Figure 4 is a medical laser treatment apparatus similar to that of Figure 2 but shown in more detail; and,

Figure 5 shows a prior art modulation system for a laser diode.

## DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

In Figure 1 there is shown a medical laser

treatment apparatus (MLTA) 10 comprising a light emitting means in the form of a laser diode 12 and a control means in the form of a control unit 14.

The laser diode typically operates at 780 or 830 nm which corresponds to wave lengths of laser light which cause higher DNA/RNA synthesis, increased cellular membrane-permeability and a higher speed of cell reproduction, together with increased local blood circulation and intensified immune defence system response compared with other commonly used wavelengths, e.g. 632.8 nm from He-Ne laser. Typically, the laser diode operates at a power output of between 1 mW to 100 mW so as to allow penetration a biological structure of an animal which is to receive medical treatment. Power outputs at the high end of the range are required for reaching biological structures at greater depths into the tissue of the animal. It has been found that the rate of synthesis of DNA/RNA due to laser light stimulation has a maximum at both 780 nm and 830 nm. There are further maxima at 620 nm and 670 nm but these correspond to an increase of absorption of the laser light due to melanin in the animal tissue, especially for humans. The laser diode 12 conventionally includes a photo sensor 16. The photosensor 16 conventionally detects when the laser diode 12 is entering optical run-away and automatically limits the output of the laser diode 12 so as to protect same from damage. In the present invention the photosensor 16 is also used to sense the intensity of the laser light reflected from the surface of the skin of the animal to provide a feedback signal on an output 17 of the laser diode 12. The feedback signal is fed back to the control unit 14.

The control unit 14 comprises one or more microprocessors 18 including RAM, ROM and input/output ports, a keypad 20, an LCD display 22, an audio warning system 24, a trigger 26, a power controller and modulator 28, a power supply regulator 32, a constant current charger 34, a rechargeable battery 36, a DC input 38, and an on/off key operated switch 40. Each of the components 20, 22, 24,

26, 28, 30, 32 and 34 are connected to the microprocessors 18.

The microprocessors 18 include a MASTER microprocessor and one or more SLAVE microprocessors. The MASTER microprocessor controls the basic operation of the MLTA 10 and the SLAVE microprocessors typically control dedicated functions therefor such as the power controller and modulator 28, the power monitor 30 and the audio warning system 24. The microprocessors 18 are provided with bus slots for accepting print circuit boards carrying further facilities. For example, one slot can carry a speech synthesis board for providing a multi-lingual speech capability for giving step by step guidance instructions to an operator of the MLTA 10 conducting medical treatments.

The MASTER microprocessor is programmed with control instructions for effecting biologically compatible treatments for animals. For example, the MASTER microprocessor is programmed with instructions for operating the laser diode 12 at a prescribed power level and, modulation type, for a prescribed period of time for the treatment of ,say, leg ulcers, bed sores, herpes virus infections, burns, dermatitis, acne and the like.

The keypad 20 allows an operator to activate the facilities of the microprocessors 18 and to respond to instructions sought therefrom. The display 22 is typically a 40 character wide and 4 line long LCD display although, other types of display could be used, such as, for example, dot matrix or colour LED displays, liquid crystal or a CRT display. The display 22 is typically intended to display the following information: power level, kind of wave form, modulation, energy level, coupling efficiency and location of meridian points (for acupuncture) - which information is provided by the microprocessors 18.

The audio warning system 24 is typically an electroacoustic transducer, such as, a piezo speaker, and is configured to provide an audible warning to signify that the MLTA 10 is in operation. Preferably, the audio warning is biocompatible, being provided with tones which the animal

being treated finds soothing and relaxing. For example, the audible warning could be a multiple of an alpha wave (i.e. multiples of 9.12 Hz), multiples of other brain wave frequencies, and the like.

The trigger 26 is coupled into the microprocessors 18 in similar manner to the keypad 20. The trigger 26 is physically located on a probe (not shown) which houses the laser diode 12 or on the floor as a foot operated switch. The trigger 26 is used for activating and deactivating operation of the laser diode 12.

The power controller and modulator 28 connects the laser diode to the microprocessors 18, and under direction of the microprocessors 18 controls the power output of the laser diode 12 and where required effects a modulation of the intensity of the light output from the laser diode 12. For example, the power controller and modulator 28 may control the laser diode 12 to provide a power level of approximately 6mW with a modulation of 9.12 hertz particularly for use in acupuncture. Modulation of the intensity of the laser light is equivalent to an acupuncturist manipulating acupuncture needles. The frequency of 9.12 hertz is typically selected for acupuncture treatment as it represents an alpha frequency for gentle and harmonising stimulation of meridian locations. The power controller and modulator 28 is also capable of effecting other forms of modulation of the light output from the laser diode 12 responsive to control from the microprocessors 18 or from an external source. For example, the modulation may be in the form of a square wave, sine wave, triangular wave, music waveforms and/or any composite wave forms, depending on the most appropriate modulation for the medical treatment being undertaken.

The power monitor 30 is connected between the photosensor 16 of the laser diode 12 and the microprocessors 18. The power monitor 30 measures the rate at which light energy from the laser diode 12 is reflected from the skin of the animal back into the laser diode 12, and provides a feedback signal to the microprocessors 18. The

microprocessors 18 are programmed to calculate the coupling efficiency of the laser light into the skin of th animal by calculating the ratio of the power level at which the laser diode 12 operates and the reflected energy measured by the power monitor 30. The microprocessors 18 then boost the operation of the power controller and modulator 28 to compensate for energy lost by reflection, provided the laser diode 12 is not operated above its rated maximum power i.e. provided there is head-room available. Thus, the power monitor 30, the power controller and modulator 28 and the microprocessors 18 coact to ensure the required amount of light energy is coupled into the biological structure substantially independently of the amount of light energy that is reflected by the animal's skin.

The microprocessors 18 include a photosensor (not shown) for use in measuring the energy density of the laser light emitted from the laser diode 12. Such measurement is particularly important where collimators are used to focus the laser light. Consequently, the energy density can be measured, and assessed to determine whether or not it is suitable, before treatment commences. The measurement is also important when the laser light is diffused to cover a larger area. The microprocessors 18 automatically adjust the treatment time to compensate for the change in area.

The power supply regulator, the constant current charger 34, the battery 36 and the DC input 38 constitute a power supply 41 for the MLTA 10. The DC input 38 receives DC power such as from a power pack providing unregulated DC output. The DC power is provided to the microprocessors 18 by the power supply regulator 32 and the laser diode is supplied via the on/off key switch 40. The battery 36 is of the rechargeable type, typically a nicad battery, and is charged via the constant current charger 34 under control of the microprocessors 18 so as to apply the appropriate DC voltage to the battery 36 to effect a constant current charging rate and to reduce the charging rate to a trickle or to zero when the battery 36 has achieved an appropriate amount of charge, as is known in the charging

characteristics of nicad batteries. The battery 36 allows operation of the MLTA 10 remote from an external power source.

In use, the key switch 40 is turned to an ON position to supply electrical power to the remainder of the MLTA 10. The power is supplied either from the DC input 38 or the battery 36. The operator then enters an access code into the keypad 20 to activate the microprocessors 18 to allow operation of the laser diode 12.

The laser diode 12 can then be operated by pressing the trigger 26. The trigger 26 may be either foot or hand operated. Upon operation of the trigger 26 the microprocessors 18 direct the power controller and modulator 28 to operate the laser diode 12 at a power level set either by the operator, via the keypad 20, or by a predetermined set of instructions for a standard treatment type from the microprocessor 18.

The laser diode 12 is then directed in known manner for effecting medical treatment of the animal. A proportion of laser light enters as heat energy into biological structures of the animal and the remaining proportion is reflected. The reflected proportion is detected by the photo sensor 16. The power monitor 30 measures the amount of light energy reflected and the microprocessors 18 then control the power controller and modulator 28 to boost the laser diode to achieve the desired intensity of light energy directed into the biological structure.

The display 22 typically shows the power level, the type of waveform, the modulation of waveform, the energy density, the energy input (actual), the energy output of the laser, the coupling efficiency, the location of meridian points and the like. Upon activation of the laser diode 12 the audio warning system 24 is activated to indicate that the laser diode 12 is in operation. The warning is typically a biocompatible frequency or frequencies especially for relaxing and soothing the animal.

In Figure 2 there is shown a second embodiment of

a medical laser treatment apparatus (MLTA) 100 similar to the MLTA 10 and therefore like numerals denote like parts. The MLTA 100 differs from the MLTA 10 in that it includes a temperature sensor 102 and a Peltier device 104 in the laser diode 12. The MLTA 100 also has a temperature monitor 106 and a Peltier driver 108 connected to the temperature sensor 102 and the Peltier device 104 respectively.

The Peltier driver 108 operates the Peltier device 104 to cool the laser diode 12 so as to stabilise the temperature of operation of the laser diode 12. The temperature monitor 106 provides feedback signals to the microprocessors 18 for further control of the Peltier driver 108 so as to maintain the temperature sensed by the temperature sensor 102 within predetermined limits. Accurate control of the temperature of the laser diode 12 is preferred to ensure that the wavelength of the emission of laser light is substantially constant. Stability of the wavelength of the laser emission is crucial in effecting optimum medical treatment and optimum laser epidermic penetration for achieving maximum DNA/RNA stimulation as described hereinabove.

In use, the MLTA 100 operates in the same manner as the MLTA 10 except that the laser diode 12 is temperature stabilised.

In Figure 3 there is shown a further laser treatment apparatus 200 similar to the MLTA 10 and therefore like numerals denote like parts. The MLTA 200 differs from the MLTA 10 in that it has a master unit 202 and a slave unit 204. The slave unit 204 has a slave microprocessor 201 associated with the operation of the power controller and modulator 28, and is located remote from the master unit 202. The slave unit 204 also incorporates the trigger 26, the power controller modulator 28, the power monitor 30 and a UHF transceiver 205, a DC input 206 and a rechargeable battery 208. The master unit 202 is similar to the control unit 14 but also includes a UHF transceiver 210 for communication with the UHF transceiver 205 of the slave unit 202. Alternatively, communication could be via inductive

pick up between a docking station and a wand housing the slave unit 204, the recess being of complimentary shape to the wand. The inductive pick up is designed for transfer of data at high frequency and for transfer of power (for charging the battery 208) at low frequency. Hence, electrical contact between the master unit 202 and the slave unit 204 is not required.

The slave unit 204 controls communication with the other microprocessors 18 of the master unit 204 and controls the operation of the power controller and modulator 28. The power controller and modulator 28 is controlled according to the type of medical treatment to be performed, either automatically under control of the microprocessor 18 or manually under the control of the user of the MLTA 200.

In Figure 4 there is shown an MLTA 300 similar to the MLTA 100 of Figure 2 and therefore like numerals denoting like parts. The MLTA 300 of Figure 4 is shown in more detail than the other MLTA's 10, 100, 200.

The MLTA 300 also comprises an Omni-waveform Programmable Precision Modulator (OPPM) 302 and a self-calibration monitor 304. Both the OPPM 302 and the self-calibration monitor 304 and connected to the microprocessor 18 and are under the control of the microprocessor 18.

The OPPM 302 comprises an external modulation source processor 306, an internal modulation source processor 308, a laser bias level adjustor 310, a modulator 312 and a signal buffer 314. The external modulation source processor 306 has an input preamplifier 316 and a level adjustor 318 connected to the preamplifier 316. The input preamplifier 316 is typically receives an audio signal from an external audio generator. Typically, the input preamplifier 316 has a frequency response of 10 Hz to 10kHz to limit the range of audio signals to be modulated. The level adjustor 318 ensures that the audio signal is within preset voltage limits, such as, for example, 2Vp-p. The level adjustor automatically hard-limits audio signals in excess of the preset limits. The characteristics of the level adjustor 318, such as, for example, the voltage

limits, are under the control of the microprocessor 18. An output of the level adjustor 318 is connected to the modulator 312.

The internal modulation source processor 308 processes signals synthesised under control of the microprocessor 18. The processor 308 comprises an oversampler 320, an address generator 322, a buffer 324, an arbitrary waveform generator 326 and a waveform level controller 328. The oversampler 320 has a digitally controlled voltage source 330 in the form of a DAC (such as a 16 bit DAC) controlled by the microprocessor 18, and a precision voltage to frequency converter 332 in the form of an ADC. The microprocessor 18 calculates the amount of oversampling to be used by the processor 308 and sets the digitally controlled voltage source 330 accordingly. The oversampling is set to an amount to reduce distortion in the signal being processed by the processor 308. The use of over-sampling reduces the need for expensive and complex filters.

The oversampler 320 samples the synthesised audio signal and the result is stored into the buffer 324. Th samples are then sequentially outputted to the arbitrary waveform generator 326, which is sin the form of a DAC. The analogue output of the arbitrary waveform generator 326 is level conditioned by the waveform level controller 328 and outputted to the modulator 312.

In both cases the modulator 312 conditions the signal to the signal buffer 314 which is in the form of a power op-amp. The output of the signal buffer 314 (referred to as a modulation signal) controls the radiant power output of the laser diode 12 via a laser driver 336. The signal buffer 314 is controlled by the laser level adjustor 310 so that no peaks (especially negative going peaks) of th analogue modulation signal become clipped at the supply rails. The laser bias l vel adjustor 310 is in turn controll d by the microprocessor 18.

The self-calibration monitor 304 monitors the voltage, current and temperatur of the laser diode 12, the

feedback voltage of the photosensor associated with the laser diode 12, and the voltage and current of the peltier device 104. The current of the laser diode 12 is monitored for controlling the laser diode between "spontaneous photon emission" and "stimulated photon emission". Such control fine tunes the operation of the laser diode 12. The temperature is monitored to detect changes in frequency and allow the microprocessor 18 to control the peltier driver 108 to adjust the temperature of the laser diode 12 to maintain the frequency of operation of the laser diode 12 substantially constant.

In use, the OPPM 302 functions to modulate the power output of the laser diode 12 with various waveforms at different repetition frequencies typically in the range from 0.1 to 10,000 Hz. The different waveforms can be synthesised under the control of the microprocessor or received from external audio sources. The self-calibration monitor 304 produces a feedback signal which is monitored and control placed over the Peltier driver 108 and the laser bias level adjustor 310 so that the average power output from the laser diode 12 is substantially constant or varies according to the modulation signal in a desired manner. Such control over the laser diode 12 is important for using the laser diode 12 as a precision instrument in medical treatments.

An artificial intelligence system may be included in the MLTA's 10, 100, 200, and 300, for example, for rapid identification of meridian locations for acupuncture and display of the locations on the display 22. The artificial intelligence system may also provide recommended treatments with the laser light i.e. for acupuncture or other medical treatments.

Typically, the microprocessors 18 are provided with serial output ports for communication with peripheral devices such as printers, plotters, personal computers and the like. Typically, the microprocessors 18 are provided with input ports for receiving digital or analog signals for controlling the power controller and modulator 28 for

effecting alternate forms of modulation so that virtually any form of modulation can be applied.

A significant factor inhibiting the wide spread acceptance of laser light treatments is that clinical trials into its effectiveness, its side effects, its placebo effects and the like, can not be conducted with prior art laser light treatment apparatus. The prior art apparatus provide a square wave modulation of the laser light at dubious energy levels and without feedback control. Furthermore, the square wave modulation of the prior art apparatus, is not well suited to all types of medical treatments in which laser light can be used. It would be preferable to employ sinusoidal modulations since they are more in tune with the sinusoidal pattern of the natural biorhythms of the animal being treated. Although, in some cases, such as magnetotherapy type treatments, square waves are preferred and which are typically swept between 10MHz and 250MHz so as to simulate a broad range of cells of the biological structure. Modulation of the light has been found to have an effect similar to the enhancement achieved by manual stimulation of an acupuncture needle. Thus, it is anticipated that various modulation types may provide various medical treatment schemes.

The MLTA's 10, 100, 200 and 300 have the advantage that any form of modulation of the laser light can be generated and so the modulation can be tailored to the treatment to be performed - based on experimental results and knowledge. The MLTA's 10, 100, 200 and 300 modulation arrangements can be stored, such as on a PC, and downloaded for later use - thus providing reproducability of treatment schemes. Hence, the MLTA's 10, 100, 200 and 300 can be used as scientific instruments for clinical trials. By the use of PC's "double blind" treatment experiments could be conducted - whereby neither the operator or the animal knows the actual treatment scheme. Therefore, it may be possible to identify any placebo effect involved in the use of medical light treatments.

Also, a treatment scheme can be saved and reused

later on other animals and/or downloaded and used on other similar MLTA's 10, 100, 200, and 300 such as in the development of standard treatments for given medical conditions. Hence, laboratory standard results for medical light treatments can be developed and disseminated to others for use in the same treatments.

Further, by the display 22 the MLTA's 10, 100, 200 and 300 can identify the locations, such as meridian locations (for acupuncture) and the like, at which the treatment is to take place. Still further, the MLTA's 10, 100, 200 and 300 can be provided with an Artificial Intelligence System to assist in determination of appropriate treatments to use for a given animal and appropriate variations of the treatment to make allowance for special circumstances regarding the given animal.

The MLTA's 10, 100, 200 and 300 also have the advantage that the actual energy input into the biological structure can be measured and controlled and treatment times adjusted according to the efficiency of energy coupling. Also, the MLTA's 10, 100, 200 and 300 can provide guidance in the medical treatments being performed e.g. location of meridians, preprogrammed treatment times/energy intensities, modulation waveforms and the like. Also, the audio warning, required by law to indicate the operation of the laser diode 12, can be biocompatible and can thus assist in the medical treatment. Accurate operation of the laser diode 12 can be achieved with the Peltier device 104 and so optimum stimulation of DNA/RNA achieved for most efficient application of laser energy. By the use of multiple microprocessors individual functions can be controlled in real time. Also, the accuracy of control achieves reproducability of treatment schemes and hence the MLTA's 10, 100, 200 and 300 can function as laboratory instruments and provide clinical trials in this field for the first time.

The MLTA's 100 and 300 have the further advantage that the temperature of the laser diode 12 can be monitored and controlled to gain greater stability in the operation of

the laser diode 12. Similarly, the voltage and current fo th laser diode 12 can be monitored and the operation of the laser diode 12 controlled accordingly.

The MLTA 300 has the further advantage that the of the modulation of the laser diode 12 can be controlled accurately to avoid distortion and hence avoid operation of the laser diode 12 at unknown power levels.

It would be apparent to a skilled addressee that numerous modifications and variations can be made to the described MLTA's without departing from the basic principles of the present invention. For example, the keypad 20 could have a dedicated keypad layout and labelling, i.e. non-QWERTY. The keypad 10 could be replaced with a voice command module and a voice synthesiser. All such variations and modifications are to be considered within the scope of the present invention the nature of which is to be determined from the foregoing description.

## CLAIMS

1. A medical light treatment apparatus for the treatment of biological structures in animals, including humans, with light energy, the apparatus comprising:

light emitting means for directing light energy into a biological structure of the animal;

light sensing means for detecting light energy reflected back from the animal and for generating a feedback signal indicative of such reflected light energy; and,

control means operatively connected to the light emitting means, the control means being responsive to said feedback signal;

whereby, in use, said apparatus can accurately control the intensity of the light energy emitted by the light emitting means for increasing the intensity of the light emitted from the light emitting means when the light sensing means senses light being reflected back from the animal, the control means can thereby control the intensity of the light energy actually penetrating into the biological structure of the animal.

2. A medical light treatment apparatus according to claim 1, in which the light emitting means is a laser and the light sensing means is a photo detector operatively associated with the laser, wherein the control means boosts the power to the laser to compensate for light energy reflected from the biological structure.

3. A medical light treatment apparatus according to claim 2, in which the control means has a power for controlling the energy level and the duration of operation of the laser for coupling a required amount of light energy into the biological structure to effect a desired medical treatment.

4. A medical light treatment apparatus according to claim 2, in which the control means has a self calibration means for monitoring the operational characteristics of the laser and adjusting the power input to the laser to maintain

substantially constant wavelength of emitted light.

5. A medical light treatment apparatus according to claim 3, in which the modulator produces a modulating signal for modulating the laser for varying the light energy coupled into the biological structure, and the modulator having a laser bias level adjustor for monitoring the modulating signal and adjusting the modulating signal for substantially eliminating distortion from the modulating signal.

6. A medical light treatment apparatus according to claim 4, in which the control means has a heat transfer means thermally coupled to the laser for increasing or decreasing the temperature of operation of the laser to maintain the wavelength of the laser light generated substantially constant.

7. A medical light treatment apparatus according to any one of the preceding claims, in which the control means also has a display means for displaying the operating parameters of the laser as measured by the control means so as to verify the energy coupling and the light wavelength during treatment of the biological structure.

8. A medical light treatment apparatus according to claim 7, in which the control means has a treatment diagnosis means for directing the positioning and energy of operation to perform a desired medical treatment.

9. A medical light treatment apparatus for the treatment of biological structures in animals, including humans, with light energy, the apparatus comprising:

light emitting means for directing light energy into a biological structure of the animal;

light sensing means for detecting light energy reflected back from the animal and for generating a feedback signal indicative of such reflected light energy; and,

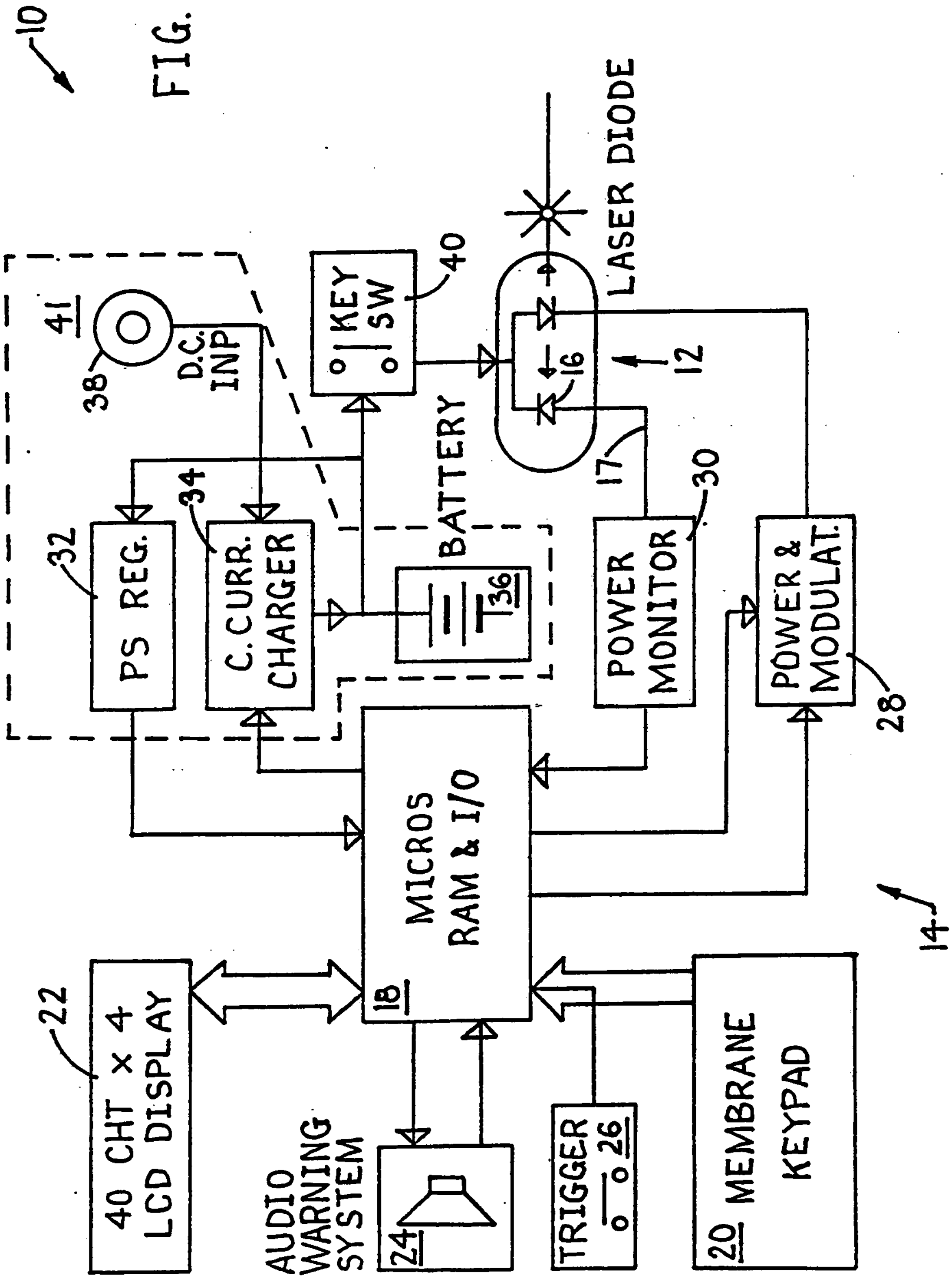
modulation m ans operatively connected to the light

emitting means, the modulation means being responsive to said feedback signal and responsive to a modulation signal;

whereby, in use, the modulation means can substantially eliminate distortion from the modulation signal and can modulate the intensity of the light energy emitted by the light emitting means according to the modulation signal.

10. A medical light treatment apparatus according to claim 9, in which the apparatus in further characterised according to any one of claims 2 to 8.

FIG. 1.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36
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30
POWER & MODULAT.
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AUDIO WARNING SYSTEM
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TRIGGER
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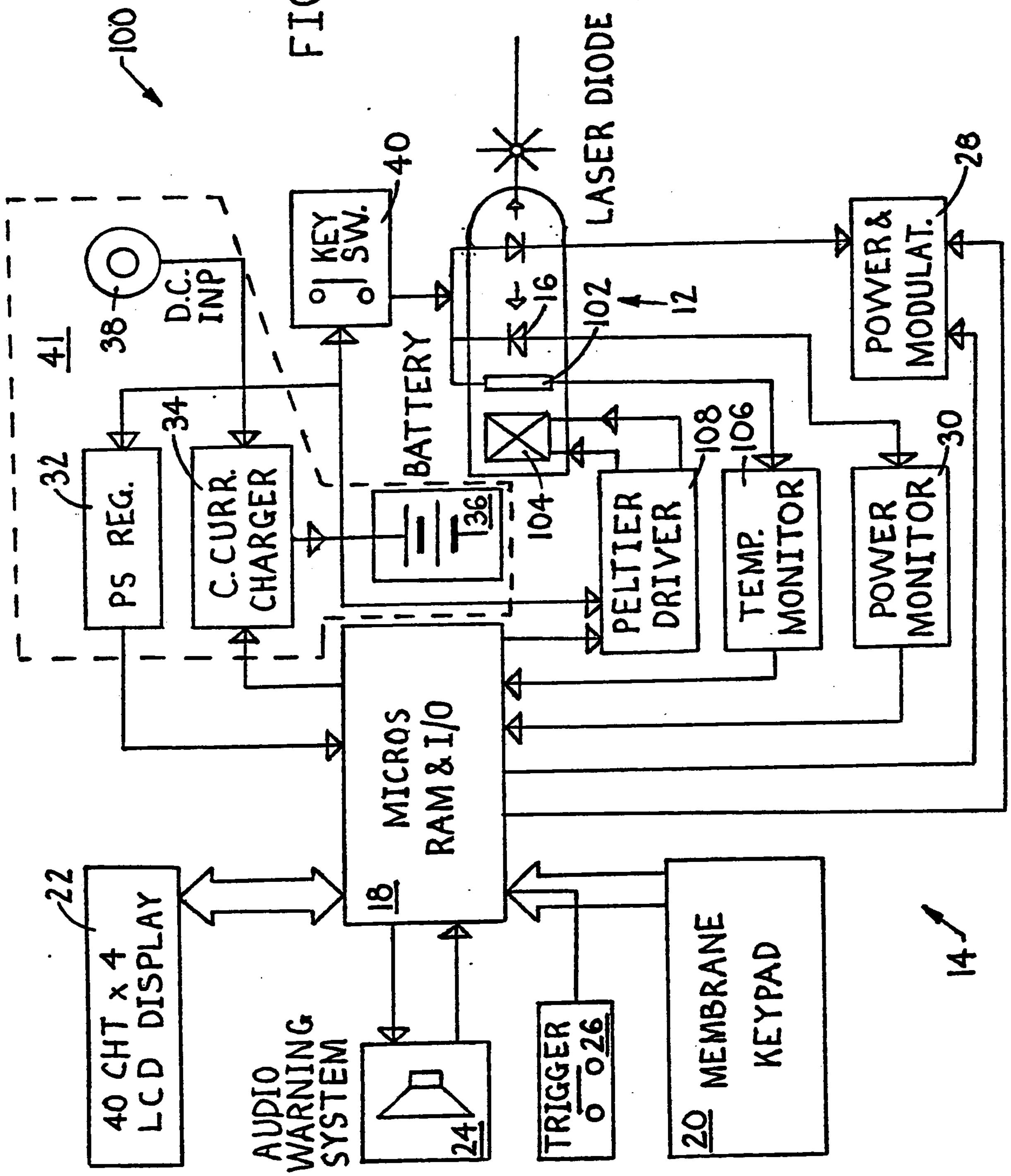
20 MEMBRANE KEYPAD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MEMBRANE KEYPAD
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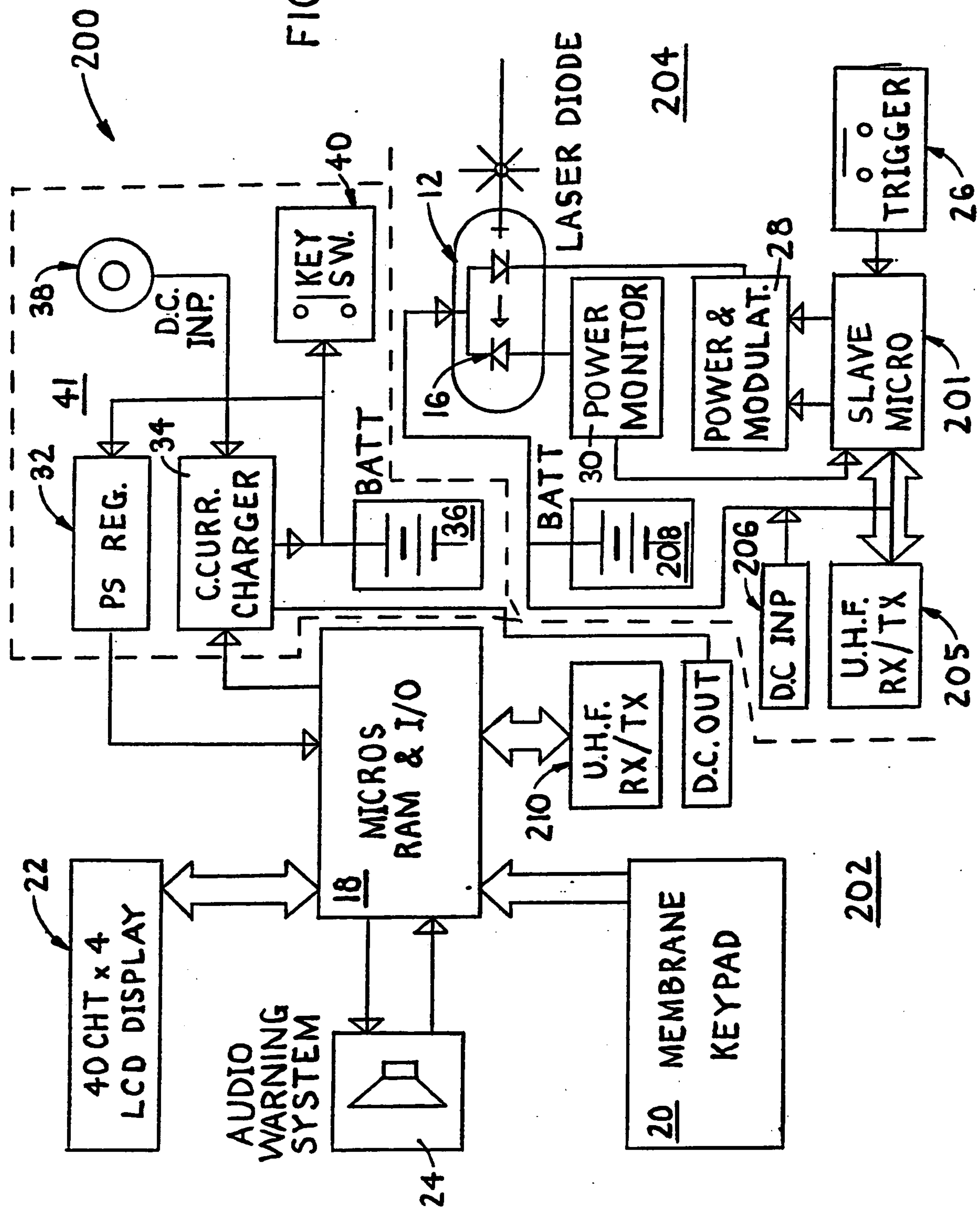
FIG. 2.

FIG. 3.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D.C. OUT
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MEMBRANE KEYPAD
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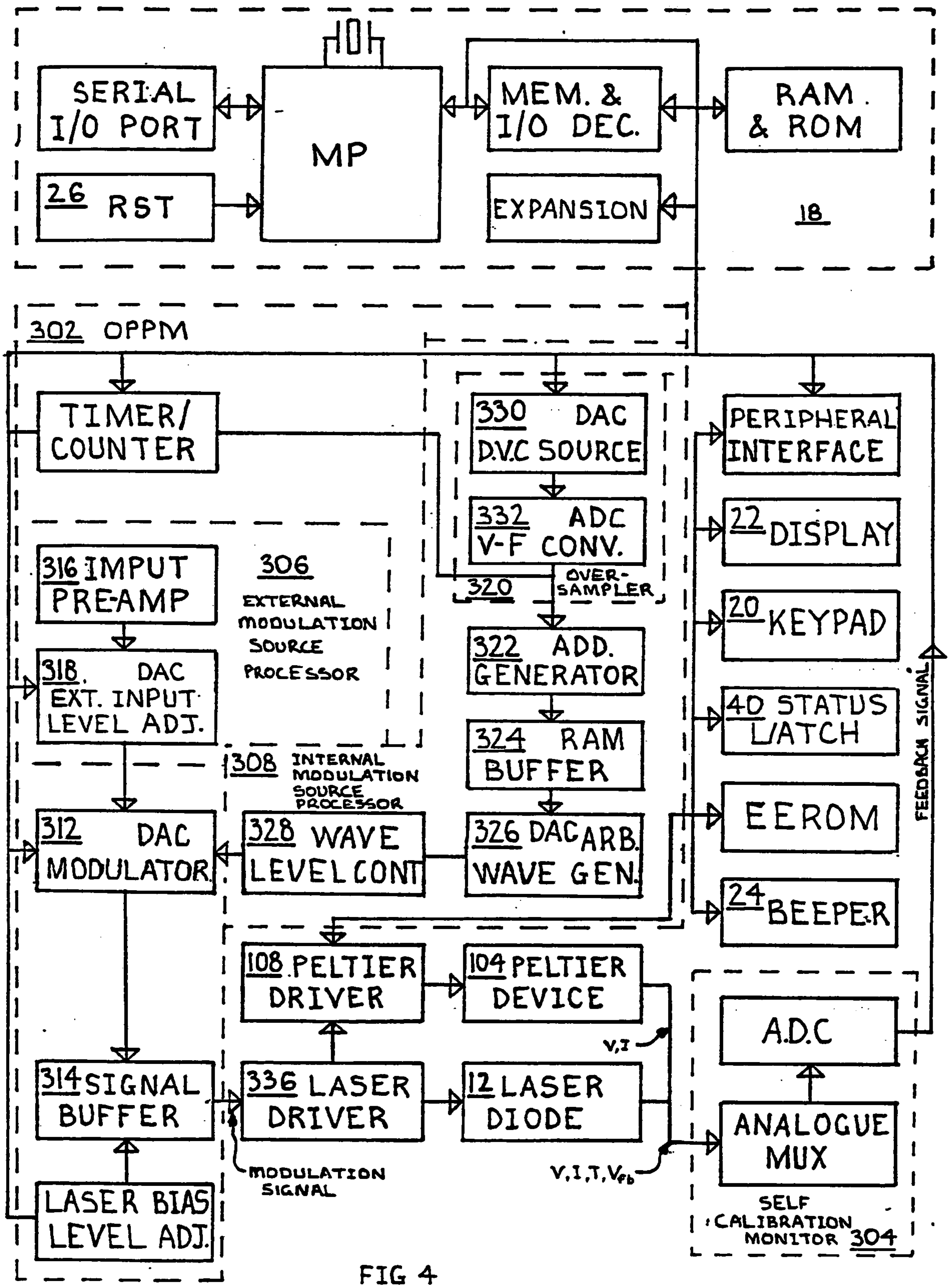


FIG 4

SUBSTITUTE SHEET

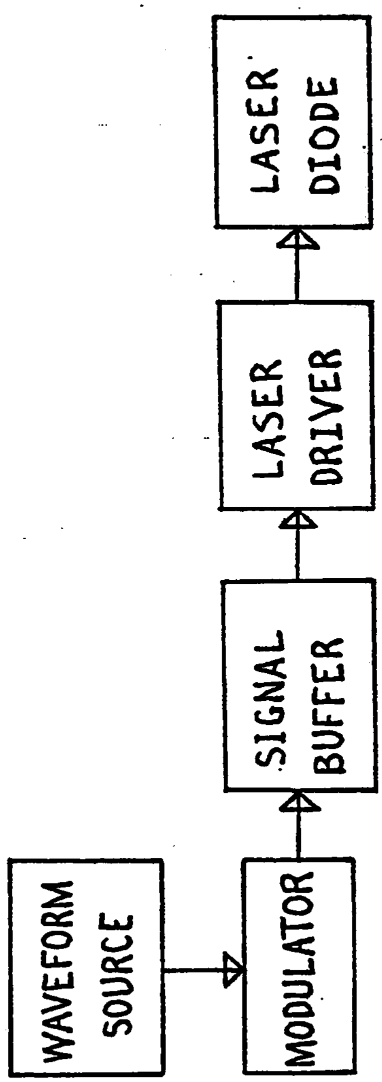


FIG 5
PRIOR ART

**INTERNATIONAL SEARCH REPORT**

International application No.
**PCT/AU92/00449**

**A. CLASSIFICATION OF SUBJECT MATTER**

Int. Cl.$^5$ A61N 5/06, H01S 3/10, 3/13

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)
IPC : A61N 5/06, H01S 3/10, 3/13

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU : IPC as above

Electronic data base consulted during the international search (name of data base, and where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to Claim No. |
|---|---|---|
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| X,P | US,A, 5071417 (SINOFSKY) 10 December 1991 (10.12.91) | 1,7 |
| Y | EP,A, 380221 (KOWA CO. LTD) 1 August 1990 (01.08.90) | 1 |
| Y | AU,B, 26923/84 (576756) (PROMED TECHNOLOGY INC.) 10 September 1984 (10.09.84) | 1 |
| Y | Patents Abstracts of Japan, C-631, page 52, JP,A, 1-139081 (OLYMPUS OPTICAL CO, LTD) 31 May 1989 (31.05.89) | 1 |

[x] Further documents are listed in the continuation of Box C.

[x] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"Y" document of particular relevance; the claimed invention cannot be considered to involv an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 24 November 1992 (24.11.92) | 1 Dec 1992 (01.12.92) |

| Name and mailing address of the ISA/AU | Authorized officer |
|---|---|
| AUSTRALIAN PATENT OFFICE<br>PO BOX 200<br>WODEN ACT 2606<br>AUSTRALIA | R. TOLHURST |
| Facsimile No. 06 2853929 | Telephone No. (06) 2832187 |

| C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT | | |
|---|---|---|
| Category* | Citation of document, with indication, where appropriate of the relevant passages | Relevant to Claim No. |
| Y | Patents Abstracts of Japan, C-631, page 52, JP,A, 1-139082 (OLYMPUS OPTICAL CO, LTD) 31 May 1989 (31.05.89) | 1 |
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| A,P | WO,A, 92/07623 (SINOFSKY) 14 May 1992 (14.05.92) | |
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| | | JP | 60500603 | US | 4719912 | US | 4880001 |
| | | WO | 84/03220 | | | | |
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| WO | 87/01948 | EP | 238574 | US | 4882598 | | |
| WO | 92/07623 | AU | 89461/91 | | | | |
| DE | 4031043 | | | NONE | | | |
| EP | 109194 | JP | 59071142 | | | | |
| WO | 88/05284 | AU | 11045/88 | EP | 301042 | JP | 1501846 |
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